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SPECIFICATION FOR THE PERFORMANCE DESIGN DEVELOPMENT  
AND TEST REQUIREMENT. (U) ADVANCED ENGINEERING LAB  
ADELAIDE (AUSTRALIA) S J CALDECOTT ET AL. 23 NOV 83

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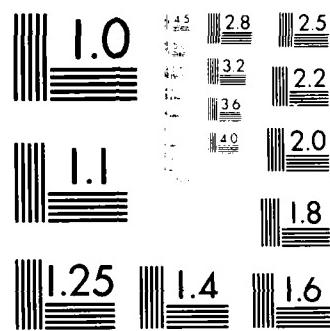
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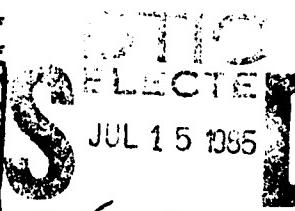
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## Airborne Structures and Instrumentation Group

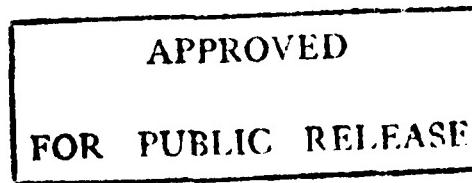
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 \* SPECIAL DOCUMENT \*  
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 \* AEL-0126-SD \*  
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 \* SPECIFICATION FOR THE PERFORMANCE, \*  
 \*  
 \* DESIGN, DEVELOPMENT AND TEST REQUIREMENTS \*  
 \*  
 \* OF A MAGNETIC TAPE CARTRIDGE REPLAY MACHINE \*  
 \*  
 \* ISSUE 1 DATE 23NOV83 Commonwealth of Australia \*  
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Prepared by S.J.Caldecott and N.J.Phillis.

## SUMMARY

This specification establishes the performance, design, development and test requirements for a magnetic tape Cartridge Replay Machine (CRM)




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This specification contains 15 sheets and is issued as a bound document. Each reissue shall be as a complete and bound document.

Issue	Date	Amendments
1	23NOV83	Original Issue.

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### 1. SCOPE

1.1 This specification establishes the performance, design, development and test requirements for a magnetic tape Cartridge Replay Machine (CRM).

### 2. APPLICABLE DOCUMENTS

Reference is necessary to the latest issue of the following documents unless otherwise specified.

#### 2.1 Advanced Engineering Laboratory

AEL-0125-SD Specification for the Performance, Design, Development and Test Requirements for a Severe Environment Cartridge Recorder

#### 2.2 DEF(AUST)

DEF(AUST)5085 The Preparation of Drawings for Service Equipment, Specification.

#### 2.3 Standards Association of Australia

AS1103 Pt 2 Diagrams, Charts and Tables for Electrotechnology; Item Designations

#### 2.4 American Military

MIL-STD-454 Standard General Requirements for Electronic Equipment

MIL-STD-461B Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference

MIL-STD-462, NOTICE 3 Electromagnetic Interference Characteristics, Measurement of

MIL-STD-810C Environmental Test Methods

#### 2.5 Other American Organisations

IRIG 118-73 Test Methods for Telemetry Systems and Subsystems

### 3. DEFINITIONS

This section is not applicable to this specification.

### 4. REQUIREMENTS

#### 4.1 Item definitions

##### 4.1.1 Cartridge Replay Machine (CRM)

The CRM shall consist of a magnetic tape cartridge reproduction machine intended for the reproduction of analogue or digital data recorded on magnetic tape cartridges by a Severe Environment Cartridge Recorder (SECR) (refer AEL-0125-SD).

The CRM shall comprise a single assembly in which shall be housed an electric motor, a means of securing and driving a magnetic tape cartridge, electronic speed control circuitry, and a four-track magnetic tape replay head. The CRM shall be powered from 240Vac, 50Hz, and shall contain no signal conditioning electronics.

#### 4.1.2 Magnetic Tape Cartridge

The magnetic tape cartridge shall be a commercial magnetic tape cartridge, such as the 3M DC100A Certified Data Cartridge, or equivalent.

### 4.2 Characteristics

#### 4.2.1 Performance

(a) Bandwidth. The CRM shall be capable of simultaneously replaying four tracks, each of which may contain either analogue signals of bandwidth 5Hz to 40kHz, within 3dB, or digital data at up to 32 kbauds.

(b) Speed. The CRM replay speed shall be settable at 10, 20, 30 or 40 inches per second (25.4, 50.8, 76.2 or 101.6 centimetres per second), within 0.5% of the set speed, in the replay direction, or 40 inches per second (101.6 centimetres per second) in the rewind direction. Speed and direction shall be selected by surface-mounted switch(es), or remotely, via a multipin connector, by an externally-provided active-low TTL-compatible signal.

(c) Wow and Flutter Wow and flutter shall be less than 1.0% RMS at all speeds.

(d) Control. CRM motor operation shall be controlled by a surface-mounted switch, or remotely, via a multipin connector, by an externally-provided active-low TTL-compatible signal.

(e) Start Delay The CRM motor shall be running at the selected speed within 400 milliseconds of the run command being applied.

(f) End-Of-Tape Stop. Optical detection of End-Of-Tape holes provided in the magnetic tape shall cause the CRM motor to stop regardless of the state of the run control line. Resetting this condition shall be achieved by removal and reconnection of power, or by the application of a Stop Reset pulse. The latter shall be provided by a momentary action switch or remotely via a multipin connector by an active-low TTL-compatible signal. Resetting the End-of-Tape Stop condition by either of the above methods shall also reset the run control command.

(g) Cartridge Restraint. The CRM shall provide a means of positively restraining the cartridge under all operating conditions, to prevent its movement relative to the head or drive mechanism.

(h) Endurance. The CRM shall be capable of replaying for up to 40 three-minute periods during an eight hour period for which mains power shall be continuously applied to the CRM.

(i) Minimum Life Expectancy. The CRM shall be designed to provide a minimum life of 4000 hours.

(j) Supply Voltage. The CRM shall operate from an external 240Vac +10%, -15%, 50Hz power supply, and shall carry a suitably rated fuse and power switch in that circuit.

(k) Manual Operation. The CRM shall allow manual operation of the tape transport mechanism by providing finger-tip access to a rotating member of this mechanism. A suitable non-slip surface for this member shall be applied to a section whose diameter is at least 10mm.

(l) Signal Buffering. The CRM shall contain electronic circuitry which provides current amplification of the signals which are produced by the tape head. The output impedance of the signals shall be 600 ohms, within 10%, and with a phase angle less than 30° over the CRM bandwidth.

(m) Remote Control The CRM shall be controllable by active-low TTL-compatible signals which shall enter the CRM through a multipin connector. Equipment to generate those signals is not described by this specification.

#### 4.2.2 Physical Characteristics

(a) Dimensions. The dimensions of the CRM shall be within the following limits, unless exemption is sought from and granted by AEL.

Width : 150mm  
Length : 250mm  
Height : 120mm

(b) Weight. The weight of the CRM shall not exceed 3.0kg.

(c) Tape Inspection. There shall be provision in the CRM case for visual inspection of both tape reels within the cartridge, showing tape distribution between reels.

(d) Feet. The CRM shall have four feet of a resilient material on its base, positioned to provide maximum stability during operation.

(e) Projections. All fixing screws, bolts, pins, studs, switches, indicators and other protruding components shall be protected from accidental damage by guards or shields, or by being recessed beneath the surface in which they are mounted. The only exceptions allowable are the feet, and the mains cable.

(f) Protective Coating. The protective coating and finish details for the CRM shall be agreed between the contractor and AEL, and shall depend on the materials used.

(g) Power Connection. Mains power shall enter the CRM via a 2m mains cable equipped with a standard 3 pin plug at the free end. The cable shall enter the CRM through a grommetted hole, and shall be anchored by a cable-clamp inside the CRM, close to the entry hole.

(h) Signal Connection. Control and signal wiring shall enter the CRM through a miniature bulkhead-mounted multi-pin connector.

(i) Tape Head Alignment. Tape head mounting on the CRM shall allow adjustment, but shall be preset by the manufacturer to establish uniform head alignment between different CRMs and SECRs. Special equipment needed to preset the heads shall be supplied by the manufacturer with instructions for its use.

(j) Tape Head Polarity. Signal connections to the tape head shall be such that a common magnetic flux pattern on all tracks of the tape shall produce a common signal polarity from all head channels. This signal shall be of the same polarity as that which produced the tape in the SECR. Drawings shall show the polarity of tape head connections required to achieve this effect.

(k) Carrying Handle. The CRM shall have a carrying handle mounted on its smallest face to aid portability. The handle shall provide an opening of at least 100mm x 20mm and shall be closed at each end.

#### 4.2.3 Reliability

The CRM shall be designed with the aim of a minimum MTBF of 500 hours.

#### 4.2.4 Environmental Conditions

(a) Temperature. The CRM shall operate over the temperature range 0°C to + 50°C. For testing refer to MIL-STD-810C, Methods 501.1 and 501.2. In both cases, test chamber temperatures shall be limited to the specified temperature limits. The CRM shall be deemed to have passed the test if the speed requirements of 4.2.1(b) are met during this test (refer 5.2.3 for speed test method).

(b) Humidity The CRM shall operate at a humidity level of 95% RH, noncondensing. For testing refer to MIL-STD-810C, Method 507.1, Procedures II and III. Test chamber temperature shall be limited to +50°C. The CRM shall be deemed to have passed the test if the bandwidth requirements of 4.2.1(a) are met during this test (refer 5.2.2 for bandwidth test method).

(c) Shock The CRM shall be capable of withstanding the transit and handling shocks it is likely to encounter. For testing, refer to MIL-STD-810C, Method 516.2, Procedures II and V. The CRM shall be deemed to have passed the test if the bandwidth and speed requirements of 4.2.1(a) and 4.2.1(b) respectively are met following these tests (refer 5.2.2 and 5.2.3 respectively for bandwidth and speed test methods).

#### 4.3 Design and Construction

Unless otherwise specified, equipment design and construction shall conform to the applicable requirements of MIL-STD-454.

##### 4.3.1 Electromagnetic Compatibility

The CRM shall be designed with the aim of compliance with the requirements of MIL-STD-461B, Part 7, Methods CEO3, CS06 and RE02.

##### 4.3.2 Markings

Each CRM shall be permanently and legibly marked with the item descriptor, and the legend "Manufactured for AEL, Defence Research Centre, Salisbury." The item descriptor, comprising the item name, identifying drawing number and serial number, shall be visible when the CRM is supported on its feet.

Markings shall show the function of all switches and indicators, and the fuse rating.

#### 4.3.3 Workmanship

The minimum acceptable level of workmanship shall be instrument standard.

#### 4.3.4 Interchangeability

The CRM component parts shall be modular and interchangeable between units to shorten and simplify maintenance tasks, except where precision matching of machined parts is necessary.

#### 4.3.5 Safety

Appropriate precautions shall be taken to prevent the accidental exposure of personnel to hazardous voltages.

### 4.4 Drawing and Documentation

#### 4.4.1 Engineering Drawings

Engineering drawings shall be prepared to level 2 of DEF(AUST)5085. DRCS identifiers and AEL drawing numbers shall be used in all drawing and parts list title blocks.

Engineering drawing types to be prepared shall include parts lists, circuit, detail and assembly drawings, and interface control drawings. Data lists and Build Status Records shall be required. The mono-detail drawing system shall be used. Parts lists separate from the engineering drawings shall be prepared at the sub-assembly level.

#### 4.4.2 Documentation

The following types of documentation shall be provided.

- (a) Design-supporting material which will describe alternative approaches considered, design philosophies, major design decisions, and calculations to validate the design.
- (b) Technical Manual, incorporating hardware description, operation and maintenance procedures, troubleshooting guide and relevant engineering drawings.

#### 4.4.3 Maintenance

Design of the CRM shall allow a level of accessibility and modularity consistent with achieving a maximum MTTR of 1 hour. Except for the head-alignment jig, the use of special purpose equipment for assembly, disassembly or testing shall be avoided.

### 4.5 Precedence

This specification shall take precedence over all referenced documents. If a conflict arises between different requirements, it shall be resolved by AEL.

## 5. QUALITY ASSURANCE PROVISIONS

### 5.1 General

Testing shall be carried out on one unit to verify that the specified requirements of Section 4 have been satisfied. Testing to prove compliance with section 4.2.4 shall be carried out at the AEL Environmental Testing Facility, jointly by AEL and contractor personnel. Any decision required during tests on repairs or modifications shall be made by AEL. Responsibility for concessions approval shall reside with AEL.

### 5.2 Tests

#### 5.2.1 Control

Local control of the CRM shall be tested by inserting a tape cartridge, switch-selecting a motor speed and commanding the motor to run by the Run Switch. The motor shall be allowed to run until end-of-tape (EOT) Stop occurs. Repeated operations of the run switch shall not then command the motor to run.

The Reset Switch shall then be operated and the motor run again in the same direction at the same speed. After a short time a second EOT Stop shall occur, whereupon the motor shall be reset and run in reverse direction past the first EOT stop until the beginning of the tape (BOT) Stop occurs. The procedure shall be repeated for each of the three remaining motor speeds.

Remote control of the CRM shall be tested by a similar sequence of operations, but commands shall be applied via the multi-pin connector from a TTL-output circuit built for the purpose by the contractor and approved by AEL.

Any failure of the CRM to carry out the above operations during ten attempts shall be deemed a failure to pass this test.

#### 5.2.2 Bandwidth

The contractor shall design a replay amplifier to connect to one channel of the four track tape head. A tape shall be recorded with sinusoidal signals of 1Vpp and frequencies of 5, 10, 20, 100, 200Hz, 1, 2, 10, 20 and 40kHz. Replaying the tape through the CRM shall provide a constant level, within 3dB, over the frequency range 5Hz to 40kHz. Successful completion of this test shall satisfy the bandwidth requirements of both this document and that of the SECR (AEL-0125-SD, 5.2.1).

#### 5.2.3 Speed

A test lead shall be attached to a point in the speed control circuit where a signal whose frequency is proportional to the drive shaft speed is available. An electronic frequency counter shall be used to measure the frequency of this signal for each of the CRM's forward operating speeds. In each case, it should be within the following range.

$$0.995k < f < 1.005k$$

where  $k = x \cdot s \cdot r \cdot C$      $x$  = number of pulses per drive shaft revolution

$s$  = tape speed (in centimetres per second)

$r$  = ratio of drive shaft speed to cartridge drive pulley speed

C = the reciprocal of the circumference of the cartridge drive pulley (=1/3.86 cm)

#### 5.2.4 Wow and Flutter

The motor shall be run and the technique of 5.2.3 used to monitor speed. The digital signal so derived shall be passed to a frequency discriminator whose output shall be measured as described in Section 3-32(g) of IRIG 118-73. The measured output shall be less than 1.0% RMS at all controlled speeds.

#### 5.2.5 Start Delay

The technique of 5.2.3 shall be used to monitor speed, while the output from the frequency discriminator of Section 3-32(g) of IRIG 118-73 shall be observed on an oscilloscope with a sweep time of 20 milliseconds per division. The oscilloscope shall be triggered by the run command, and the display used to establish that the motor reaches commanded speed within 400 milliseconds of this trigger event. The test shall be conducted for all forward i.e. replay, speeds.

#### 5.2.6 Supply Voltage

With a supplied voltage of 264Vac, and again with 204Vac the tests of 5.2.1, 5.2.3 to 5.2.5 shall be repeated for a speed of 40 inches per second (101.6 centimetres per second) only. The same criteria shall be met as in the previous tests. Failure to comply with any of those criteria shall be judged as failure to satisfy this test.

### 5.3 Functional Assessment

Following completion of the tests in 5.2, an assessment of the CRM's performance in those tests shall be made by AEL, to determine acceptability of the CRM. The contractor will be informed of the result, with any re-testing which may be necessary.

## 6. PREPARATION FOR DELIVERY

The CRM shall be prepared for delivery by ensuring that complete assembly of the unit has taken place, and that it is in an operational state i.e. all lubrication, adjustment, alignment, calibration and cleaning is complete.

The CRM shall be packaged to provide protection against damage resulting from dropping from two metres onto a concrete surface, and secured to prevent the packing coming off. The package shall be labelled with the name of the item, its serial number a consecutive package number, date of manufacture, contract number, and the names of the maker and the consignee.

## 7. NOTES

### 7.1 Intended Use

The CRM will be used to replay tape cartridges recorded by the SECR, and containing, typically, flight test data from airborne weapons or aircraft. The equipment may be used in a variety of environments, such as a laboratory or an aircraft hangar, and it is intended that the equipment should withstand the mis-handling it may receive in use or in transit.

The exclusion of signal processing electronics from this item requires the user instrumentation engineer to design replay circuitry to suit the recording signal processing circuitry he intends to use in a given data logging task.

#### 7.2 Development Background

The equipment described in this specification is based on a prototype replay unit designed within AEL several years ago to replay tapes from a prototype recorder. The original replay unit contained most of the mechanical features described in this specification, but speed control and selection, end-of-tape stop and remote operation were not available.

Background information on the prototype replay unit will be available to enquirers through the AEL contact officer.

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